

REMARKS

In response to the Office Action mailed July 12, 2004, Applicant amends his application and requests reconsideration. In this Amendment, claim 1 is cancelled leaving claims 2-6 pending.

In this Amendment, claim 2 is essentially rewritten in independent form. Claim 3 is amended solely to conform to the amended form of claim 2. Claims 4-6 are not amended.

Claim 4 was rejected as anticipated by Lee et al. (U.S. Patent 6,277,760, hereinafter Lee). This rejection is respectfully traversed.

In the process described in claim 4, a ruthenium film is deposited, after which a resist pattern is formed on that mask material, which is the ruthenium film. Then, the mask material, i.e., the ruthenium film, is, itself, patterned using the resist pattern as a mask. Subsequently, an underlying film, i.e., the film to be processed, is patterned using the ruthenium mask material as a mask.

In rejecting claim 4, the Examiner directed attention to Figures 3A-3D and Figures 4C-4E of Lee. However, it appears that the most pertinent Figures in Lee are Figures 4E and 4F. In the processing that takes place between the completion of the structures shown in those two cross-sectional figures, as described in Lee at column 4, lines 18-24, an etching step takes place "using a Ru or Cr mask...". Prior to those steps, there is no use of any ruthenium film, although reference is made to a ruthenium oxide etch stopping layer 23 that is, itself, etched in the steps between Figures 4D and 4E of Lee. However, the cited passage does not describe how the ruthenium mask is formed.

Lee does describe how a ruthenium mask is formed in the passage in column 4, in lines 57-67. The final two sentences of that passage point out that when ruthenium is, itself, etched in order to form a mask, the ruthenium film must be masked by some material that will not be etched by oxygen. Photoresist is rejected in final sentence of column 4 as such a material because photoresist can be etched by oxygen. Thus, according to Lee, titanium is used as a mask for etching a ruthenium mask material.

The cited passage of Lee makes clear that Lee rejects the possibility of employing a photoresist as a mask when etching a ruthenium mask material. By contrast, in the invention as described by claim 4 and supported in the patent application, a resist pattern is formed on the mask material, i.e., the ruthenium film, and the ruthenium film is etched using the resist pattern as a mask. Accordingly, Lee cannot anticipate that claim because Lee uses a different, non-resist mask, to mask the ruthenium film and, moreover, states

that one cannot use a resist pattern as in the invention. According, the rejection of claim 4 as anticipated by Lee is erroneous and, upon reconsideration, should be withdrawn.

Claims 2-6 were rejected as unpatentable over McKee (U.S. Patent 5,804,088) in view of Nam (U.S. Patent 6,291,251). This rejection is respectfully traversed.

In the process described by McKee, particularly with respect to its Figures 8a-8e, three layers are sequentially deposited on a gate oxide film on a silicon substrate. Those three layers are a polysilicon layer 806, a TiN layer 808, and a photoresist layer 810. In the process described in the cited figures and in other description of McKee with regard to corresponding layers, the TiN layer is referred to as a BARC layer. This term is explained in the passage from column 2, line 61 through column 3, line 3 of McKee.

“TiN layer 208 acts as a buried antireflective coating (“BARC”) for I-line lithography; that is, TiN strongly absorbs 365 nm wavelength light. Without TiN *or some other BARC* the underlying polysilicon 206 would reflect exposure light penetrating overlying photoresist and cause interference which makes the photoresist’s degree of exposure depend upon location because the photoresist thickness varies over protuberances such as isolation oxide 203.” [Emphasis added.]

Nam was relied upon with regard to its Figure 3E which shows a hard mask pattern 9 that may be ruthenium or chromium, provided an etch stop layer is ruthenium oxide. When the etch stop layer is titanium oxide, then the hard mask material is titanium. In any event, the crux of the rejection is that Nam describes a mask made of ruthenium so that it would have been obvious to replace the BARC layer 808 and form the BARC mask 821 of ruthenium, rather than of titanium nitride as described by McKee, thereby suggesting to one of ordinary skill in the art the subject matter of claims 2 and 3.

The rejection is erroneous because one of skill in the art would not replace the BARC mask 821 of Figure 8c of McKee with a ruthenium layer unless the ruthenium layer could function as an antireflection coating. In other words, unless ruthenium would strongly absorb the exposure light, for example, I-line light at a wavelength of 365 nm or some exposure light wavelength that might be used in the process described by McKee, one of ordinary skill would not make the substitution.

McKee provides no motivation for such a substitution because McKee does not describe alternative materials for the TiN layer 208 that becomes, in part, the BARC mask 821. Further, there is no teaching in Nam that ruthenium absorbs any particular wavelength of light, much less a wavelength that corresponds to any conventional

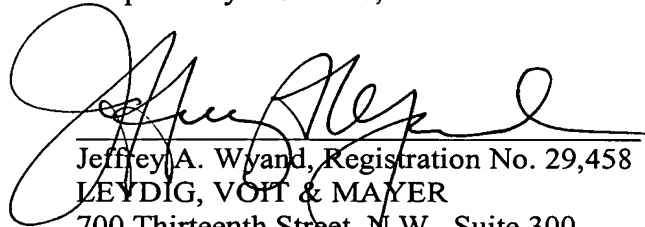
exposure light wavelength used in semiconductor device processing. Without such information, a person of skill in the art would not be motivated to replace the TiN layer of McKee with ruthenium or any other metal film because McKee expressly requires that any substitution for the TiN layer be "some other BARC". Since most metals are light reflectors, not light absorbers, McKee, absent information not in the record, teaches against the hypothesized replacement of TiN with ruthenium.

Because the essential basis for the modification of McKee with Nam is missing from both McKee and Nam, and the only information in those patents teaches against the modification, claims 2-6 cannot be obvious in view of those two references considered together.

In this Amendment, claim 2 is rewritten in independent form and claim 3 is amended solely to conform to the changes in claim 2, without any substantive change. Further, claims 4-6 are not amended in any way. Thus, any new rejection based upon newly cited prior art or a different legal ground cannot properly be a final rejection.

Reconsideration and withdrawal of the rejection as to the remaining claims are earnestly solicited.

Respectfully submitted,



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